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Utilization of Pacific Rockfish

UTILIZATION OF PACIFIC ROCKFISH. II.

Comparison of Sebastes alutus, S. reedi and S. proriger with Respect to their Quality During Chilled and Frozen Storage

BY

N. Tomlinson, S.E. Geiger, G.A. Gibbard and S.J. Westrheim

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TECHNICAL REPORT NO. 425

Utilization of Pacific Rockfish. I. Comparison of *Sebastes alutus*, *S. reedi* and *S. proriger* with Respect to Their Quality During Chilled and Frozen Storage

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INTRODUCTION

This work was undertaken to answer the question, "Are the 3 species of rockfish, Sebastes alutus (Pacific Ocean perch), S. reedi (Yellowmouth rockfish), and S. proriger (Redstripe rockfish) sufficiently alike in the quality and keeping characteristics of their flesh that they might be considered for marketing together?

Mr. Westrheim, Pacific Biological Station, Nanaimo, B.C. had found that the recently described species of rockfish, S. reedi (Westrheim and Tsuyuki, 1967) was available in quantities suitable for commercial exploitation (Harling et al, 1971) and he approached the Vancouver Laboratory for assistance in ascertaining if it might be suitable for marketing with S. alutus, the commercially popular Pacific Ocean perch, and S. proriger, with both of which it may be caught.

It was decided to compare the 3 species with respect to their quality and keeping characteristics, as judged by a taste panel, in relation to chilled (iced) and frozen storage. Free drip, which is formed during thawing of the frozen product, and which is important to the processor and the consumer, was also determined. Limited data were also obtained for samples of commercial frozen fillets of S. marinus (Atlantic Ocean perch).

MATERIALS & METHODS

(a) Source of fish

S. alutus, S. reedi and S. proriger were caught by trawl in Queen Charlotte Sound between October 3 and 5, 1971, (Harling et al, 1971) from the Fisheries Research Board of Canada vessel, G.B. Reed.

The 3 species were different in size (Table 1), S. proriger being the smallest (mean weight 1.4 lbs)., S. alutus, intermediate (1.8 lbs), and S. reedi, largest (3.2 lbs). In one catch, there was a small number of S. reedi averaging only 1.1 lbs and advantage was taken of this to examine the influence of size on quality, particularly of flesh tenderness.

(b) Storage and sampling

Each species was treated in three ways. Some fish were bulk iced, uneviscerated, in the usual commercial manner; some were eviscerated and frozen prerigor, head on; and others were filleted prerigor and blocks of the skinned fillets were frozen. At 4-day intervals

(except at the first sampling when 3- and 5-day intervals occurred because of unavoidable interference resulting from the landing of fish and equipment) samples of the iced fish were taken, cooked by microwave oven, and submitted to taste panel examination. At the same times, further blocks of skinned fillets were prepared and frozen, the yield of skinned fillets (from 90 lbs of each species) being recorded. The frozen fillet blocks were heavily glazed with fresh water and placed in polyethylene bags.

The number of small sized S. reedi caught (see above) was sufficient only for examination after iced storage and after frozen storage of prerigor-frozen, eviscerated fish.

At sea, freezing was accomplished on shelves in the ship's cold room at -40°F; ashore, in a vertical plate freezer at -30°F. All frozen products were glazed with fresh water and stored in polyethylene bags at -22°F.

The frozen fish and fillets were sampled and examined after 60, 180 and 366 days of storage. In sampling frozen fillets, 1-inch thick slabs were sawn from the block, 1/4 inch thick slab being removed and discarded before the sample was taken. After being sampled, blocks were reglazed and returned to storage. Frozen eviscerated fish were thawed in fresh water at about 60°F before being filleted for organoleptic examination.

(c) Organoleptic examination

For submission to the taste panel, samples were cooked in a microwave oven and identified by a code number only. At the first examination, 3 iced fish of each species (and of 2 sizes in the case of S. reedi) and storage history were tasted by 6 experienced tasters, i.e., 18 individual tastings for each species, size (S. reedi only) and storage history. At the same time an equal number of prerigor-frozen, eviscerated fish were sampled and tasted (in part to serve for comparison between results of separate tasting sessions) i.e., 72 individual tastings for each species and, for S. reedi only, size.

In the later examinations of frozen fillets prepared from prerigor fish and from fish iced uneviscerated for various periods, and of prerigor-frozen eviscerated fish, there were 6 individual tastings for each sample or individual fish with the exception of the prerigor-frozen fillets. The latter, because they served additionally as standards for comparison between separate tasting sessions, received 30 individual tastings.

Each sample was scored for odor, flavor, tenderness and juiciness on an 11-point scale. Odor and flavor scores of 8 or higher should be considered excellent; 7, good; 6, acceptable; 5 questionably acceptable; 4 and lower, unacceptable. Tenderness and juiciness scores should be interpreted similarly, but scores of 5 and 6 are acceptable; 4, questionably so; 3 and lower unacceptable.

(d) Measurement of free drip and flesh pH

The United States standard method for free drip from cod fillets was used in this determination (Anon., 1961). Time of holding and temperature were 2 hours and 68°F, respectively. For free drip determination from frozen, eviscerated fish, fillets for the purpose were sawn from the frozen carcass and skinned before being thawed.

The pH of thawed flesh was measured with a combination glass electrode thrust directly into a small incision.

RESULTS

(a) Yield of skinned fillets

The mean yields of skinned fillets from the several lots of each species (Table 1) were similar, but tended to decrease in the order S. proriger, S. alutus, S. reedi.

Table 1

Yield of Skinned Fillets From 3 Species of Rockfish

Species	Mean weight of fish (lb)	Yield of skinned fillets (%)[1] Mean	Range
S. alutus	1.8	29.9	28.0 to 31.0
S. proriger	1.4	31.5	28.0 to 35.0
S. reedi (large)	3.2	28.8	28.0 to 29.6
S. reedi (small)	1.1	29.0	--

[1] From 4 lots of fish, 90 lbs in each lot, except for small S. reedi, for which only 1 lot was available.

(b) Odor and flavor scores for unfrozen, iced fish and from fish frozen prerigor at sea

Taste panel odor and flavor scores for samples from each of the 3 species (and from 2 sizes of S. reedi) after various periods of storage in ice, and from comparable fish frozen prerigor at sea and stored frozen for the same number of days, are shown in Figures A1 and A2, and B1 and B2, respectively.

The 3 species kept very well for 8 days, uneviscerated in ice, as indicated by their mean scores for odor (Fig. A1) and flavor (Fig. A2) - all a little above or below 8. Their useful storage life under these conditions appeared to be 10 to 12 days. At the 12th day some individual fish received scores of only borderline acceptability as spoilage became evident. Onset of spoilage in all species was marked by an increase in the standard deviation of their mean scores, indicating some variability in rate of spoilage of individual fish. The scores for the fish frozen prerigor at sea, and examined with iced fish, were very similar to each other, and to those of fish iced for up to 8 days, but even during the short period of frozen storage involved showed a slight decline (Fig. B1 and B2).

No differences in odor or flavor attributable to species were detected. Elliott and Osterhaug (1946) have reported a similar finding for other species of Pacific rockfish.

(c) Tenderness and juiciness scores for unfrozen iced fish and for fish frozen prerigor at sea

Taste panel tenderness and juiciness scores for samples from each of the 3 species (and from 2 sizes of S. reedi) after various periods of storage in ice, and from comparable fish frozen prerigor at sea and stored for the same number of days, are shown in Figures A3 and A4, and B3 and B4, respectively.

The larger S. reedi were judged to be somewhat less tender than the other fish examined, including the smaller S. reedi. However, as the other 2 species and the smaller S. reedi were equally tender, it appears that the difference found for the larger S. reedi was probably related to size rather than species. Such a relationship has been found before with other species of rockfish (Elliott and Osterhaug, 1946). As will be seen below, the difference in tenderness between the larger S. reedi and the other fish tended to become slightly less marked as frozen storage continued (Fig. G3 and H3).

Considering the smallness of the difference in mean tenderness scores between the larger S. reedi and the other fish, and the considerable overlap in the range of their scores, it does not seem to be a sufficiently serious difference to warrant separate marketing. In addition, past experience with other species suggests that as S. reedi is fished commercially the mean size of the fish caught will decline thus reducing or eventually eliminating the difference considered.

Figures A1 to 4 and B1 to 4

Taste panel scores for odor (A1, B1), flavor (A2, B2), tenderness (A3, B3) and juiciness (A4, B4), of 3 species of Sebastes (rockfish) after storage iced, or frozen at -22°F,,for various periods up to 19 days.

Figures A1 to 4 record mean scores (n=18) for iced fish, stored round; B1 to 4, frozen fish, eviscerated, head on.

Mean scores for:

S. alutus (Pacific Ocean perch) ●——————●

S. reedi (Yellowmouth rockfish), large, o----------o

S. reedi (" "), small, x----------x

S. proriger (Redstripe rockfish) □.....□

Standard deviation of the mean score is indicated adjacent to the experimental point. When scores coincide, the point referred to is identified by the appropriate symbol in brackets.

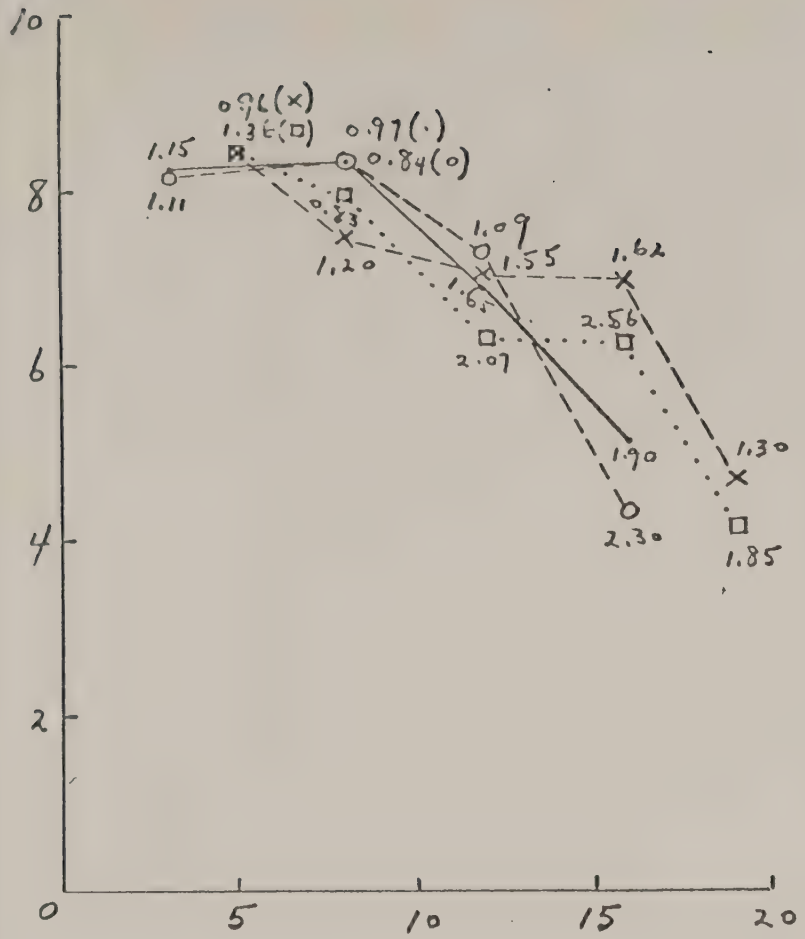

FIGURE A1

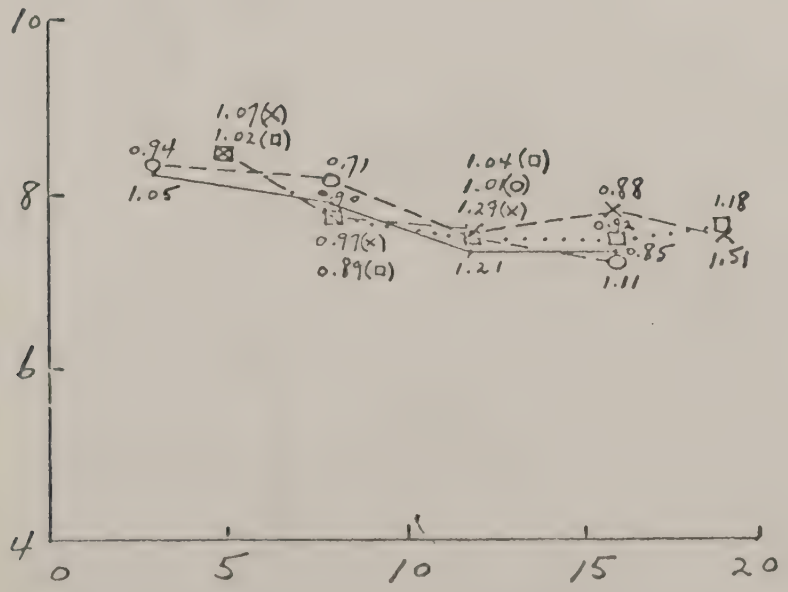

FIGURE B1

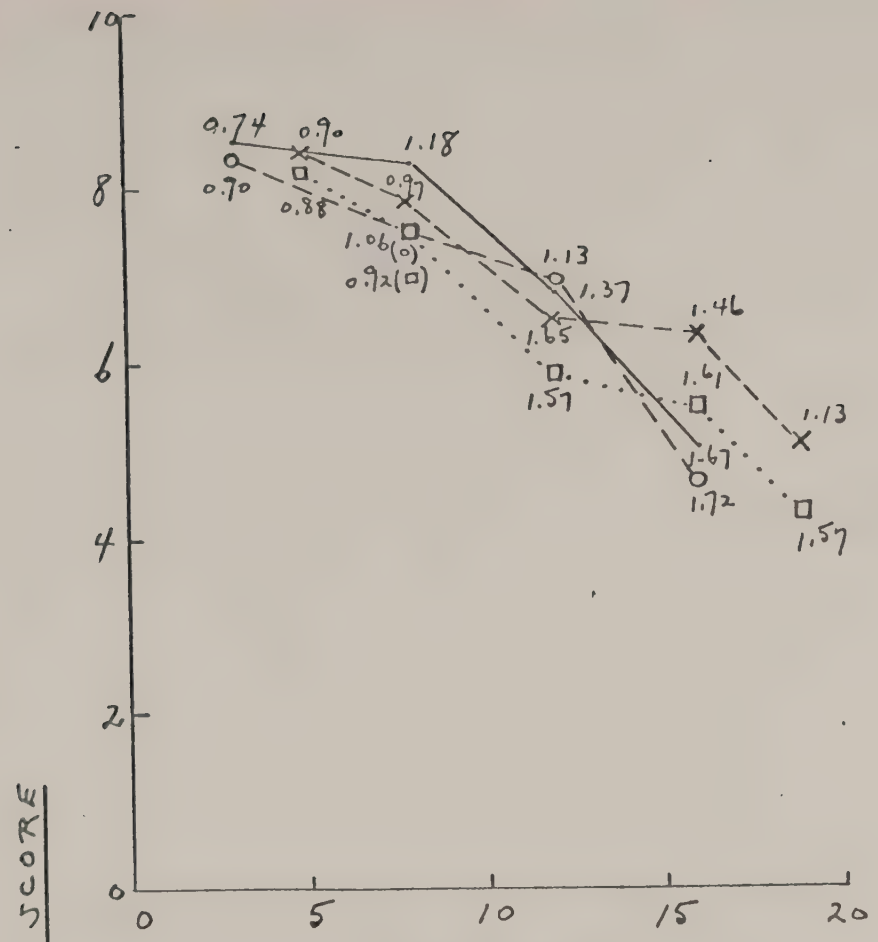

FIGURE A2

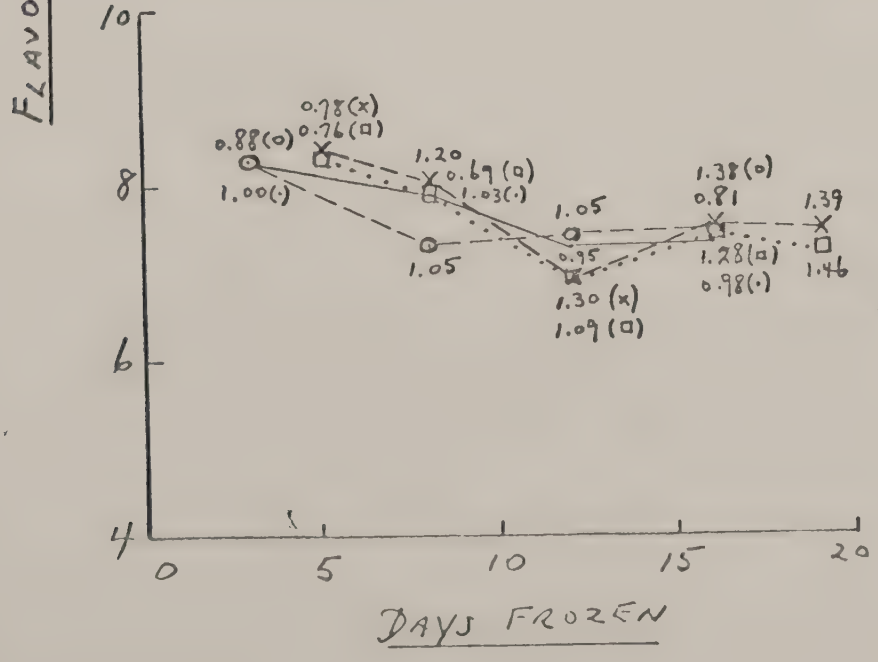

FIGURE B2

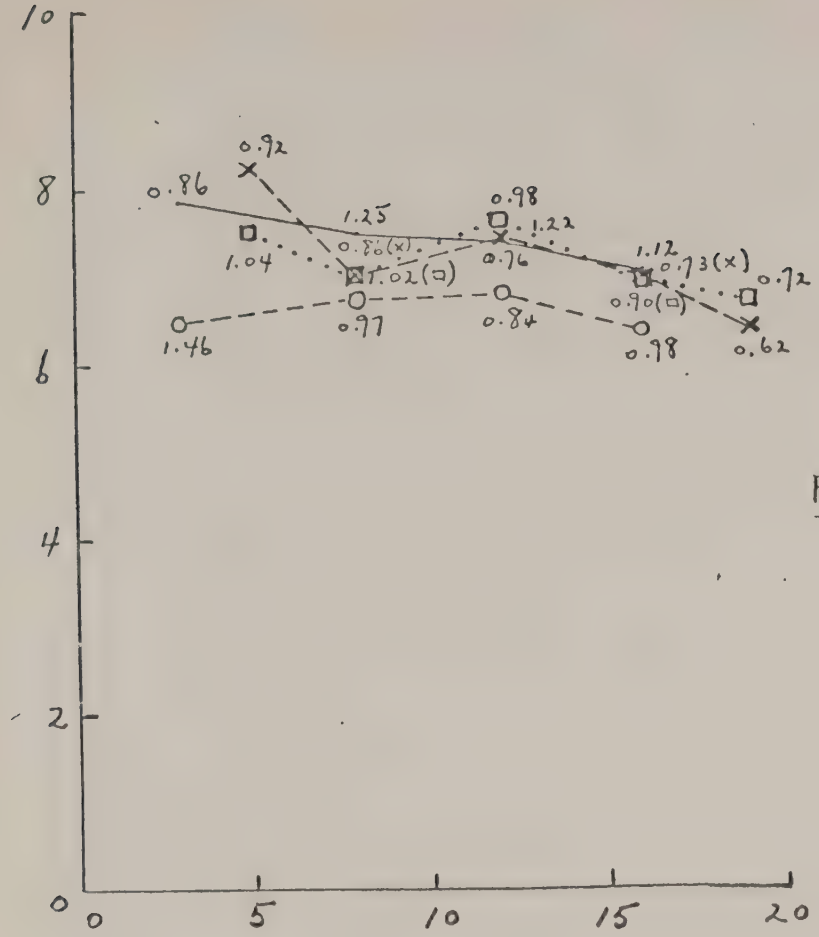

FIGURE A3

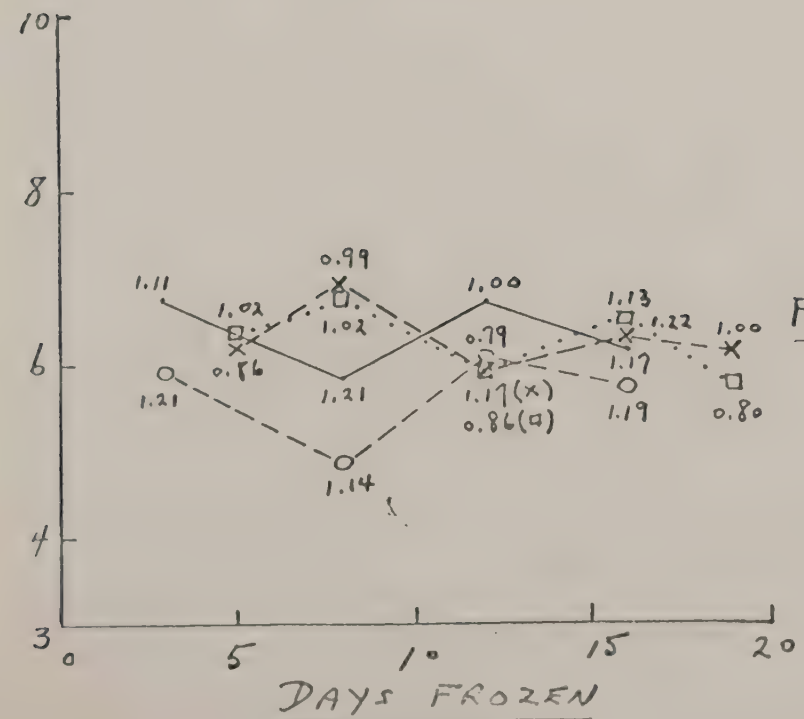

FIGURE B3

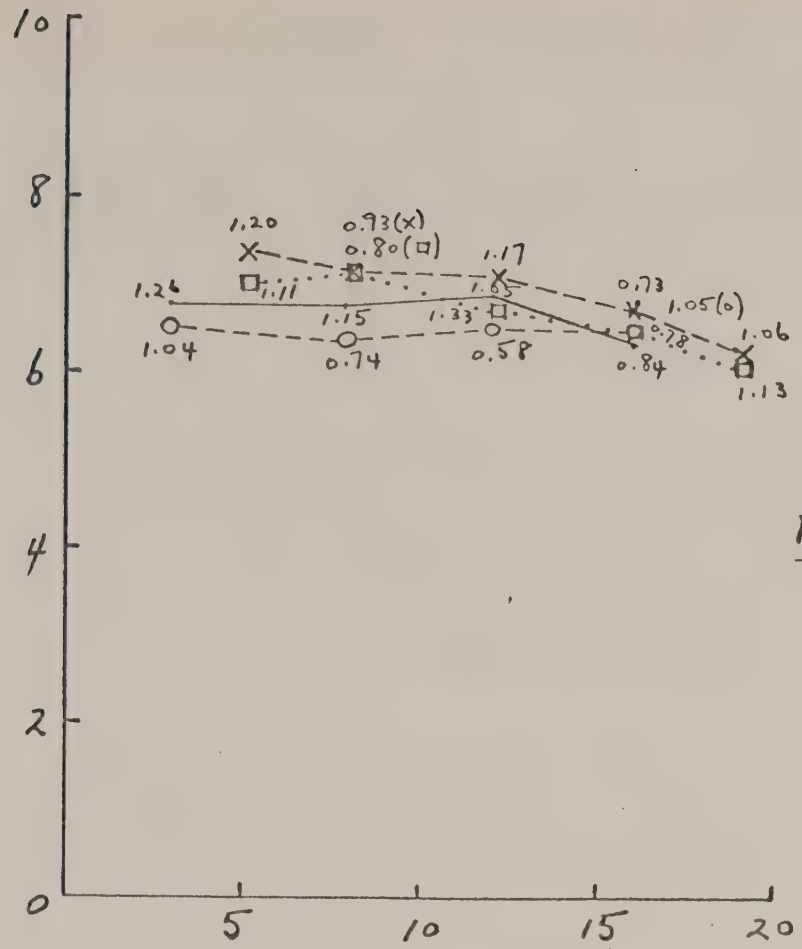

FIGURE A4

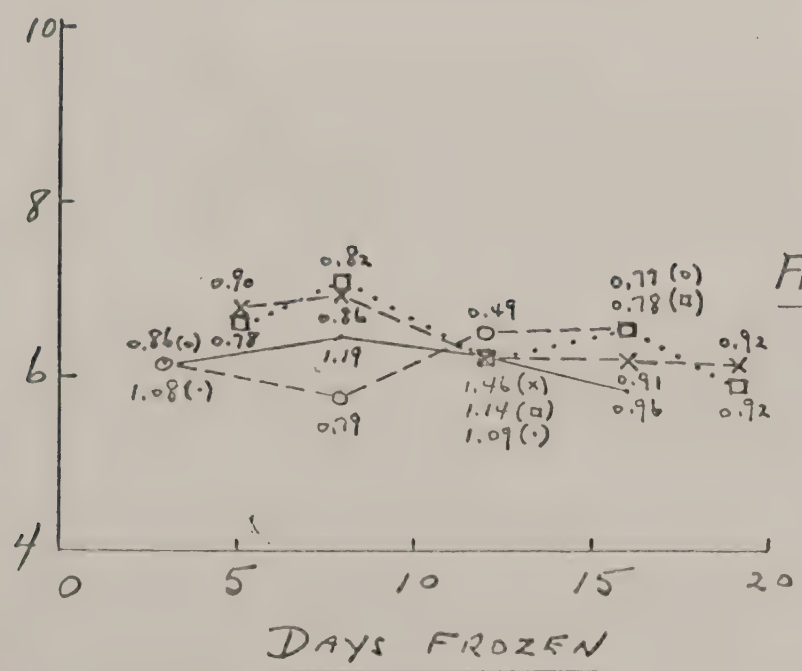

FIGURE B4

S. proriger and the smaller S. reedi tended to be judged to be slightly more juicy than S. alutus and the larger S. reedi. These differences were too small to be of any importance and again were probably more closely related to size than to species.

(d) Odor, flavor, tenderness and juiciness of fillets frozen from previously iced fish in relation to duration of iced and subsequent frozen storage

Taste panel scores for odor, flavor, tenderness and juiciness of frozen fillets prepared from round fish after various periods of iced storage are recorded in Figures C2 to 4, D2 to 4, E2 to 4 and F2 to 4, respectively. The figures numbered 2, 3 and 4 present data for fillets stored frozen for 60, 180 and 366 days,, respectively. For ready comparison, data for the fillets before being frozen are repeated in Figures C1, D1, E1 and F1. Data for S. reedi are all for larger fish, insufficient small fish of this species being caught to permit production of fillet blocks from iced specimens.

S. alutus and S.reedi fillet blocks kept well in frozen storage; those from S. proriger not quite so well, particularly as judged by odor and flavor scores. S. reedi received slightly lower mean flavor scores than did S. alutus, but this was not completely consistent and there was a good deal of overlap in the ranges of their scores. In odor, they were indistinguishable.

As discussed in (c) above, mean tenderness scores for the larger S. reedi were usually lower than those for S. alutus and S. proriger, particularly for fillets prepared from fish in the earlier stages of iced storage (to 8 days).

The poorer keeping quality of S. proriger frozen fillet blocks may again be related to the size of the fish, as the fish of this species caught were smaller than were S. alutus and the larger S. reedi (Table 1). Possibly for small S. proriger their use in frozen products should be avoided if periods of frozen storage of longer than 3 months or so are anticipated. It should be noted that as iced fish (b and c above) and as freshly frozen whole fish (e, page 20) they kept as well as the other two species.

It is curious that in this work, fillets prepared and frozen from fish after being iced for 16 days received better odor and flavor scores after frozen storage than they did before. However, in the interests of quality, it appears it would be desirable not to exceed 8 days of iced storage of these species when frozen products are to be prepared from them (see also e, page 20.).

Figures C1 to 4, D1 to 4, E1 to 4, and F1 to 4

Taste panel scores for odor (C1 to 4), flavor (D1 to 4), tenderness (E1 to 4) and juiciness (F1 to 4) of 3 species of Sebastes (rockfish) in relation to duration of prefreezing iced storage of the round fish and of the subsequent frozen storage of blocks of fillets prepared from them.

Figures numbered 1 record mean scores (n=18) for iced fish; those numbered 2, 3 and 4 mean scores (n=6) for frozen fillets after storage at -22°F for 60, 180 and 366 days, respectively.

Mean scores for:

S. alutus (Pacific Ocean perch) ●——————●

S. reedi (Yellowmouth rockfish), large o----------o

S. proriger (Redstripe rockfish) ◘.....◘

Standard deviation of the mean score is indicated adjacent to the experimental point. When scores coincide, the point referred to is identified by the appropriate symbol shown in brackets.

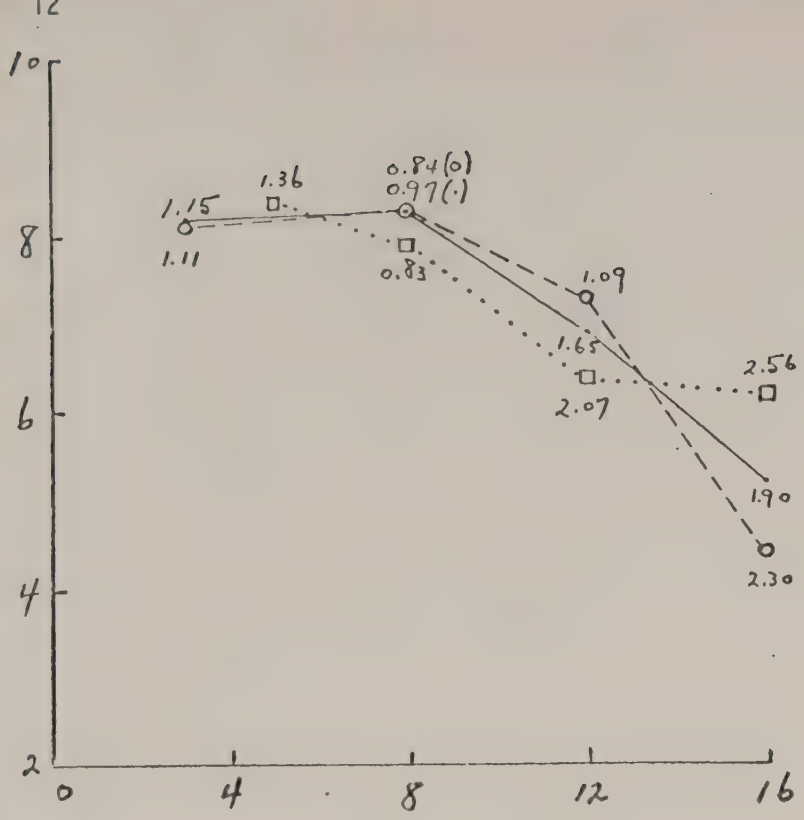

FIGURE C1

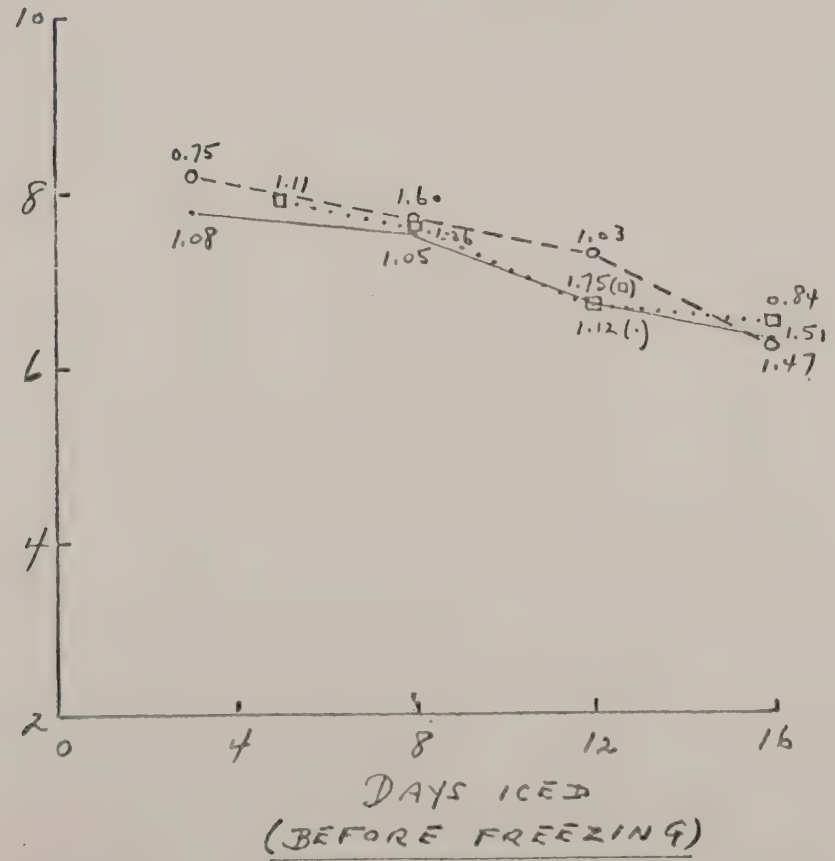

FIGURE C2

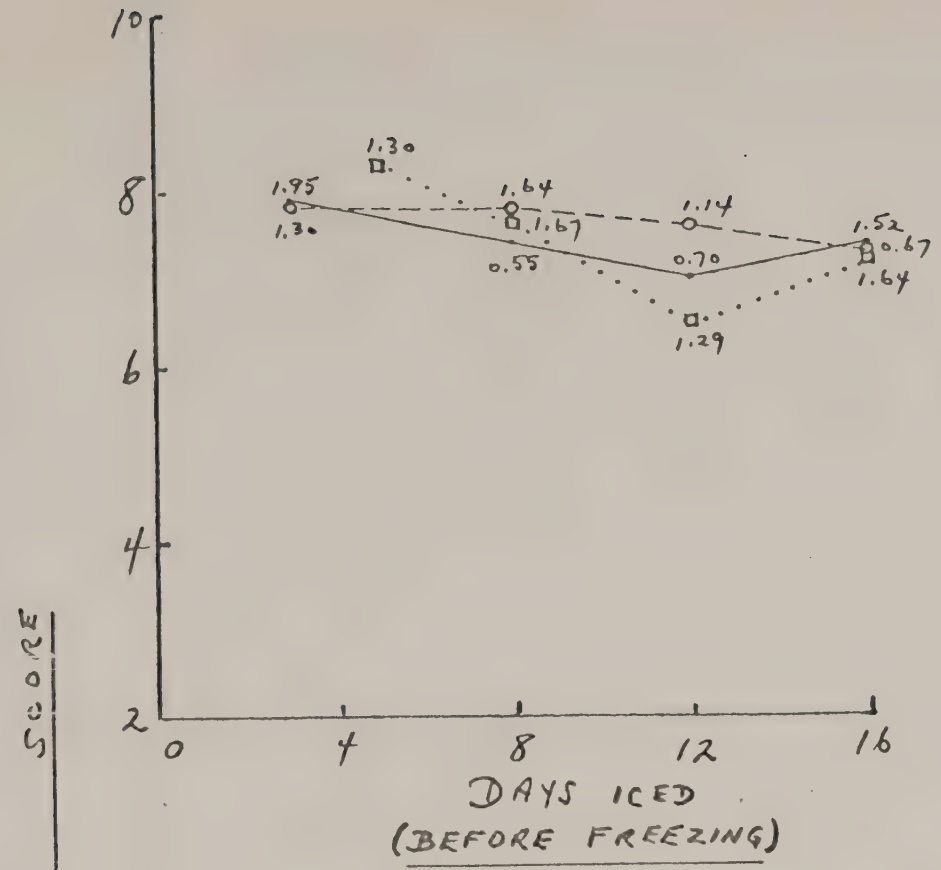

FIGURE C3

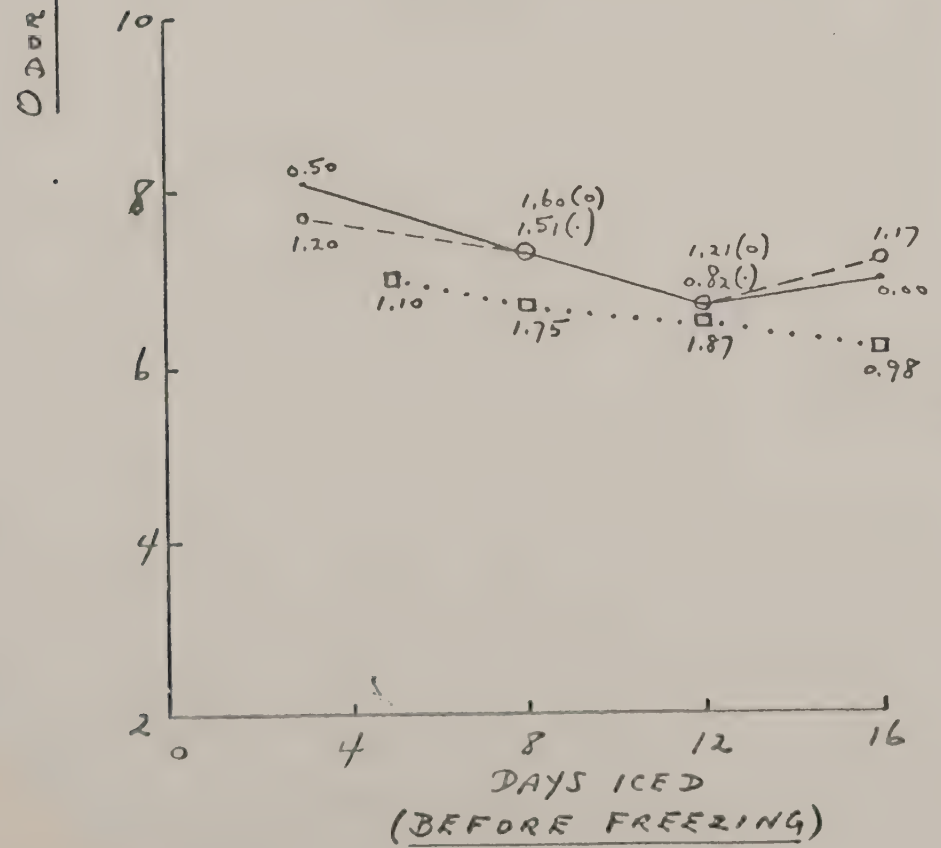

FIGURE C4

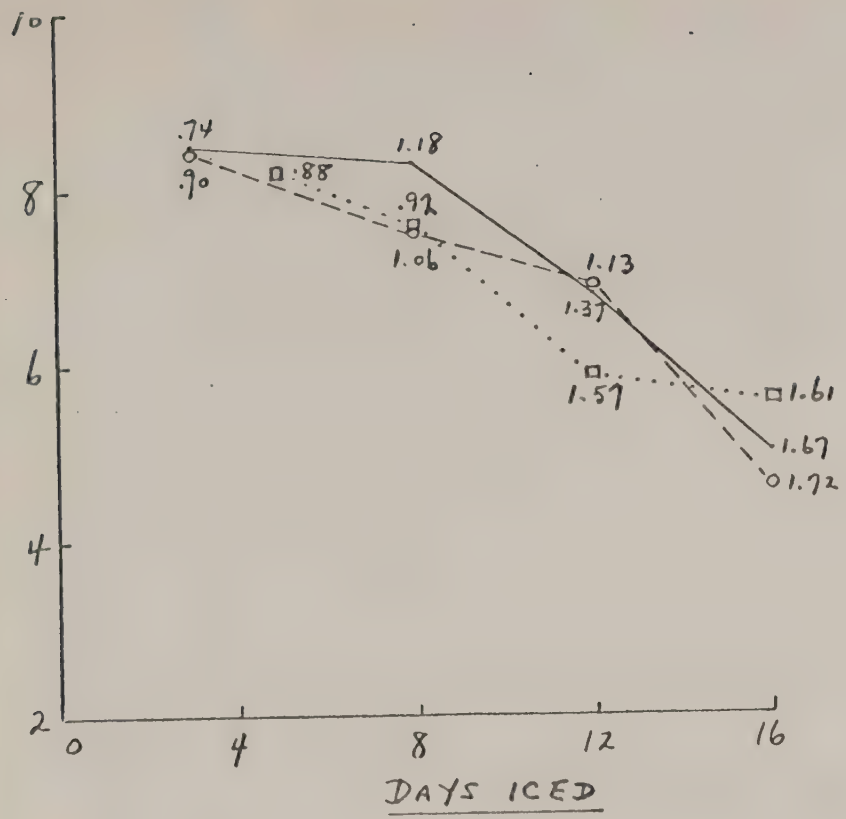

FIGURE D1

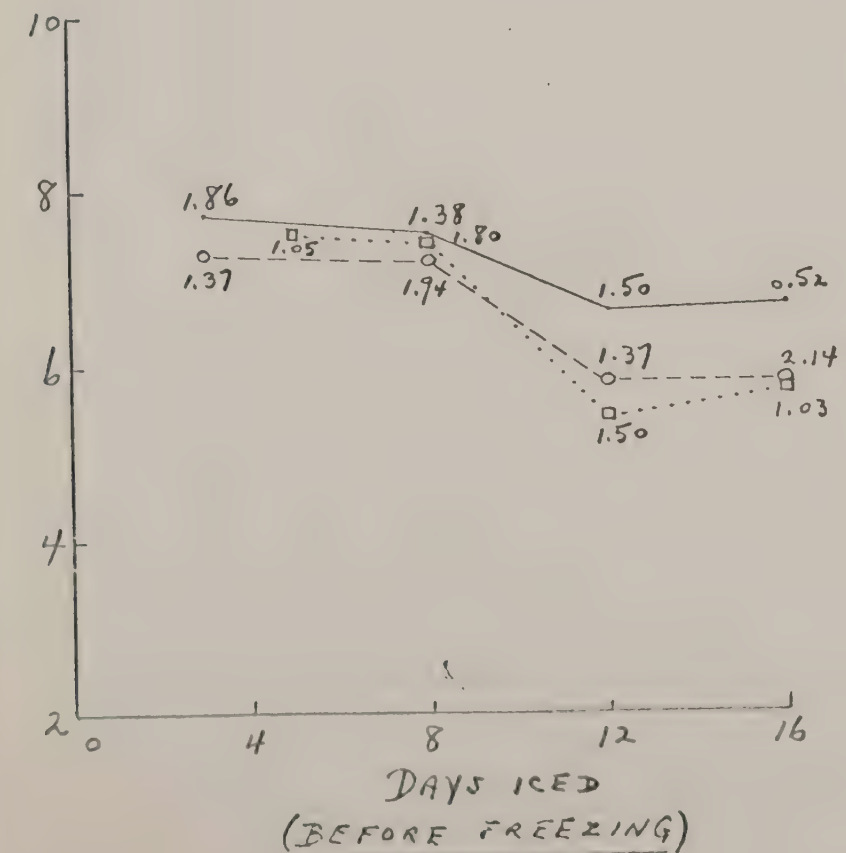

FIGURE D2

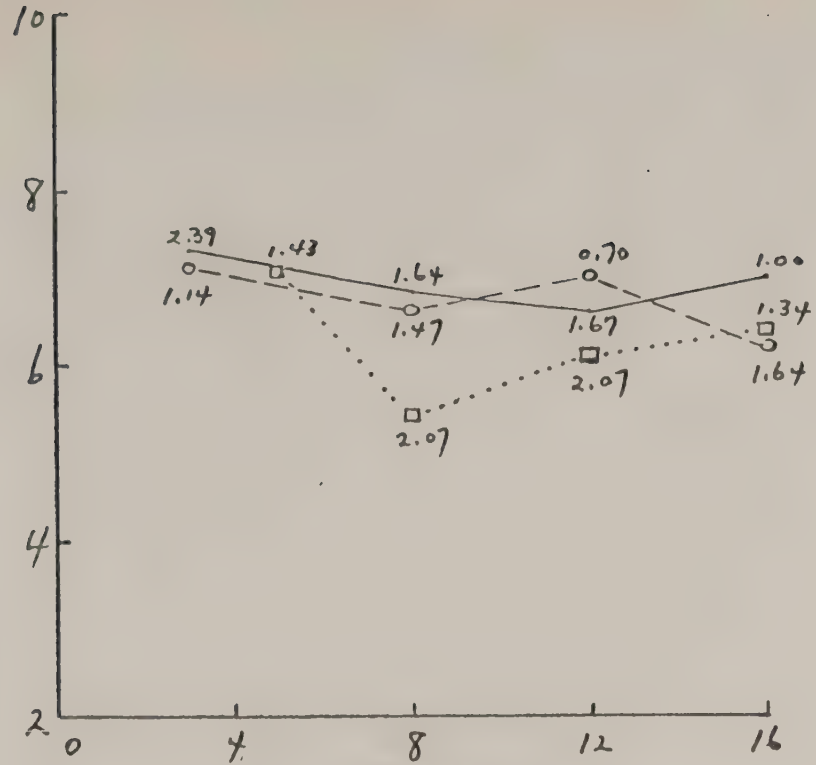

FIGURE D3

FLAVOR SCORE

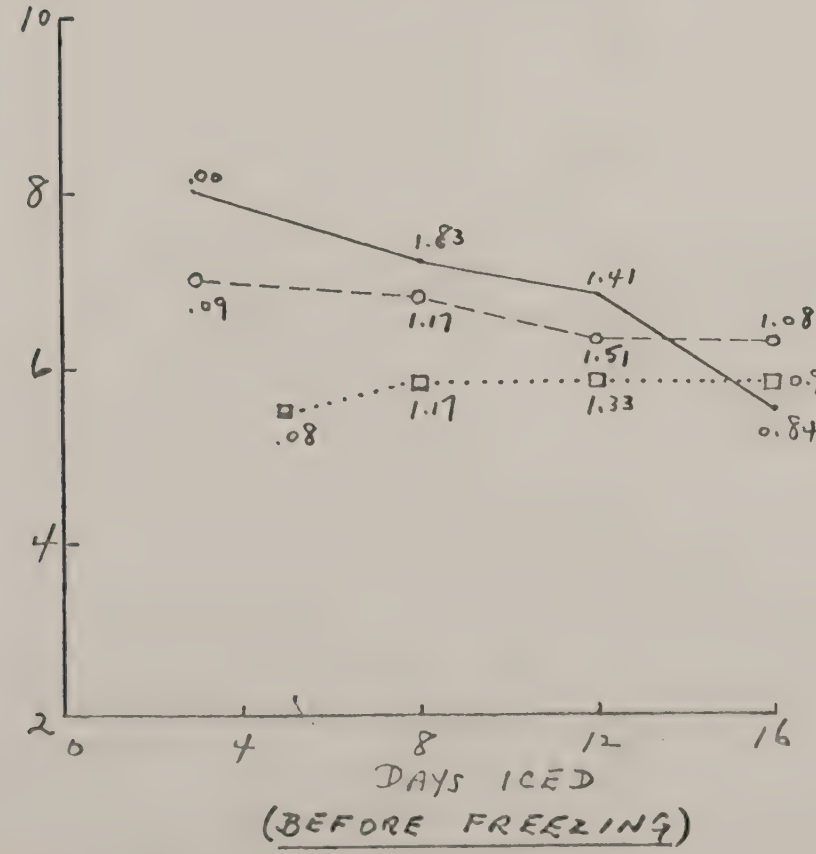

FIGURE D4

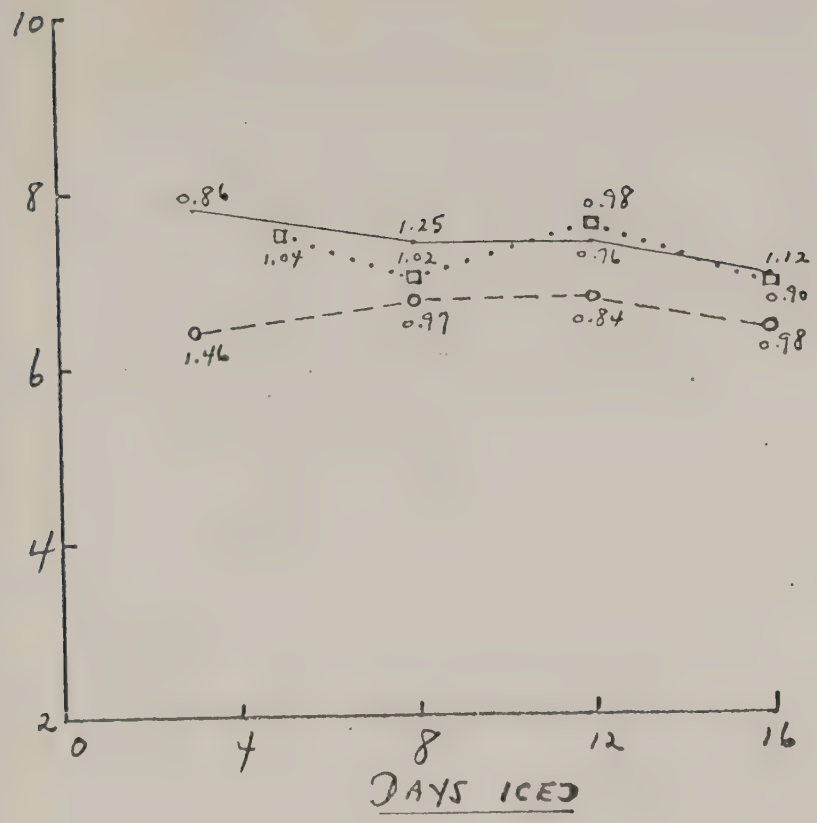

FIGURE E1

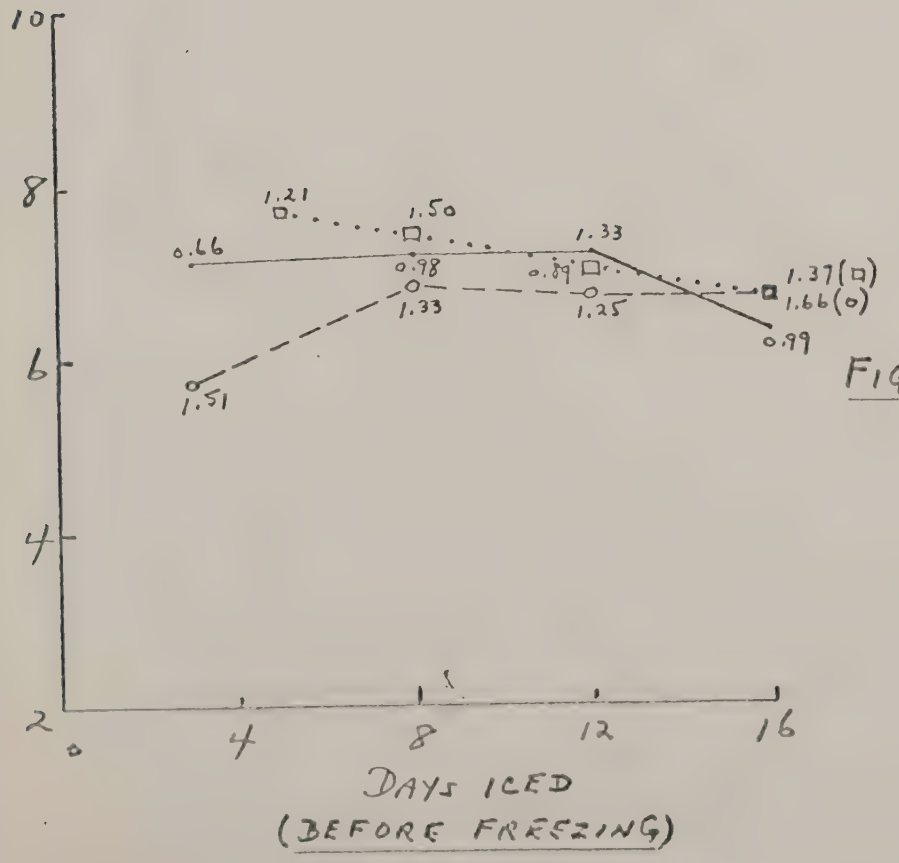

FIGURE E2

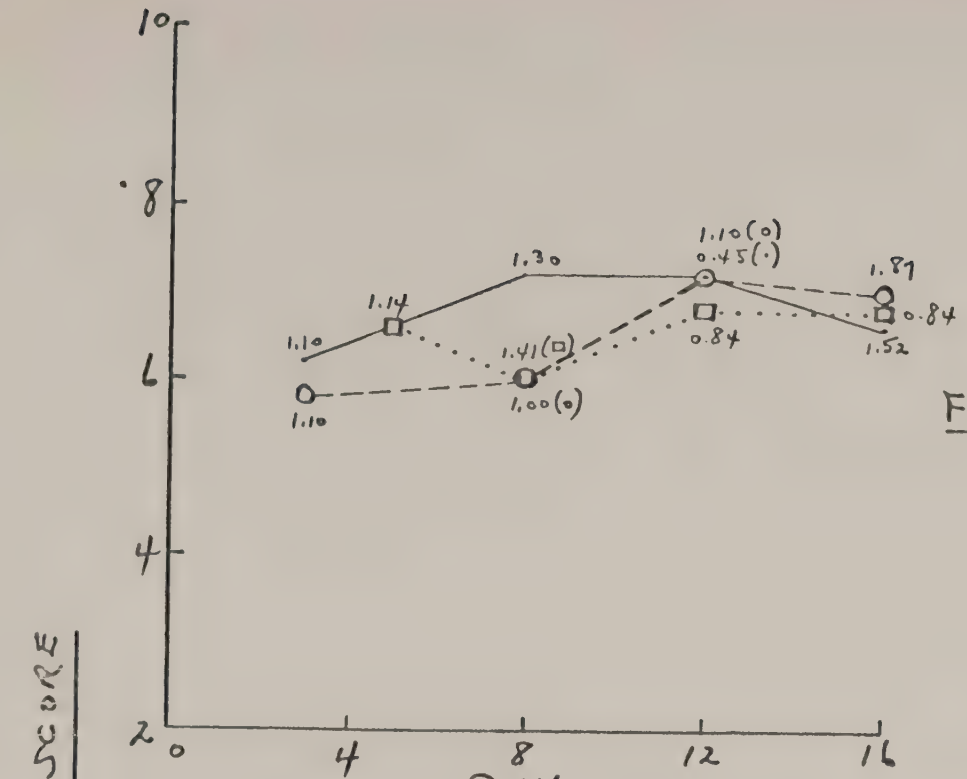

FIGURE E3

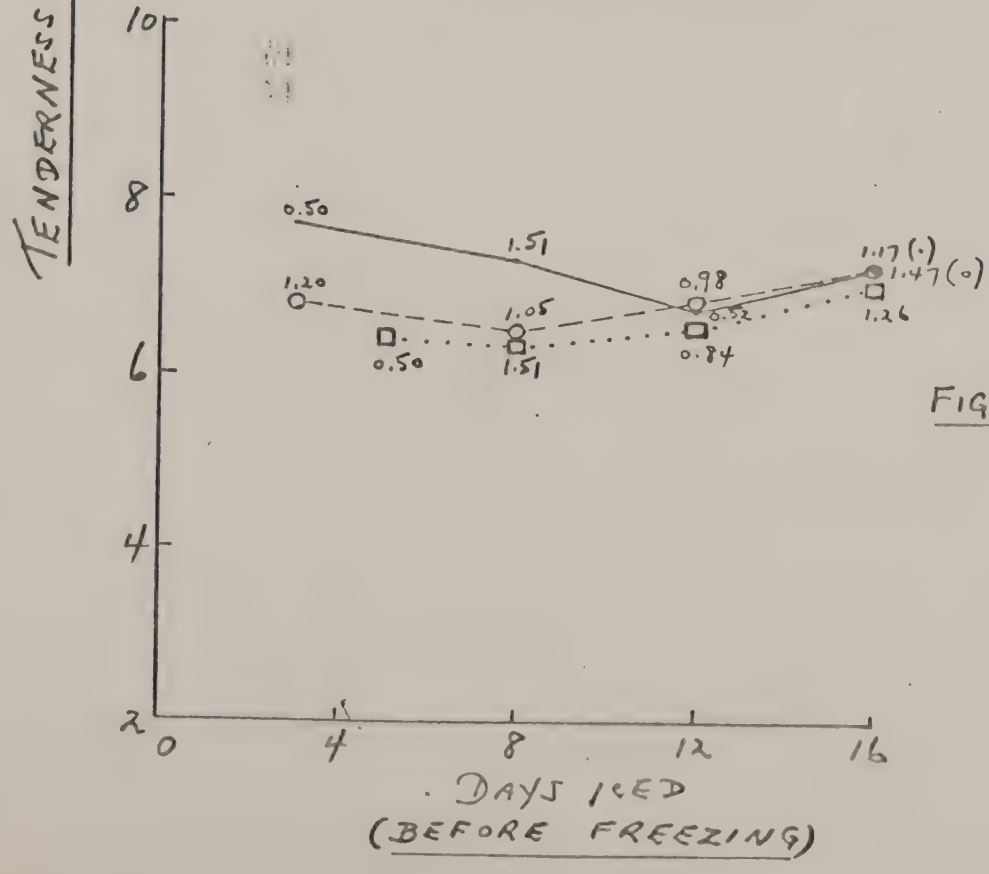

FIGURE E4

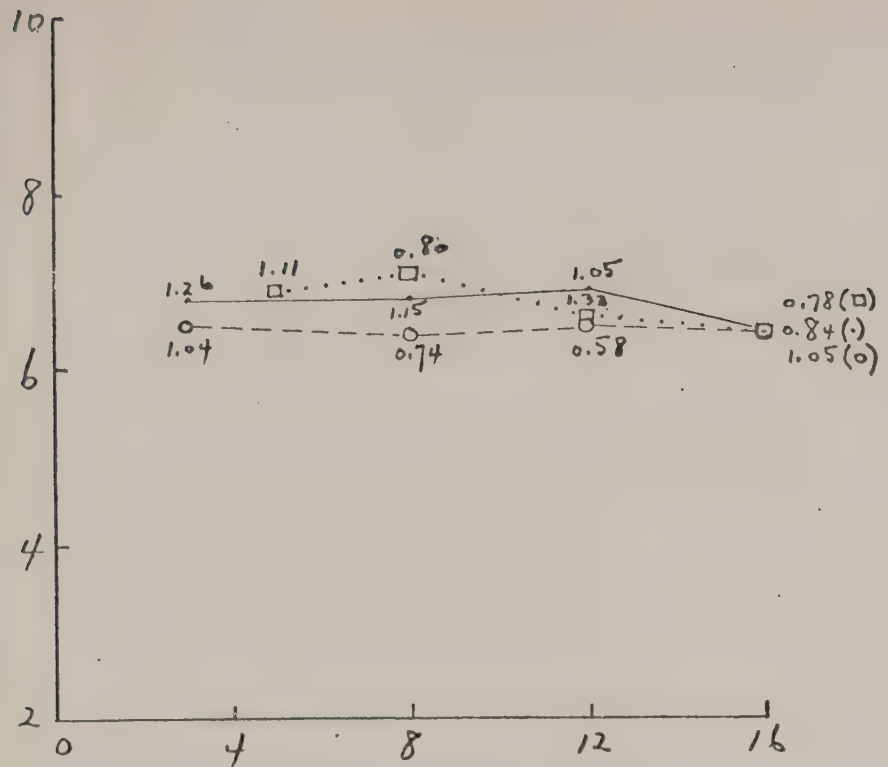

FIGURE F1

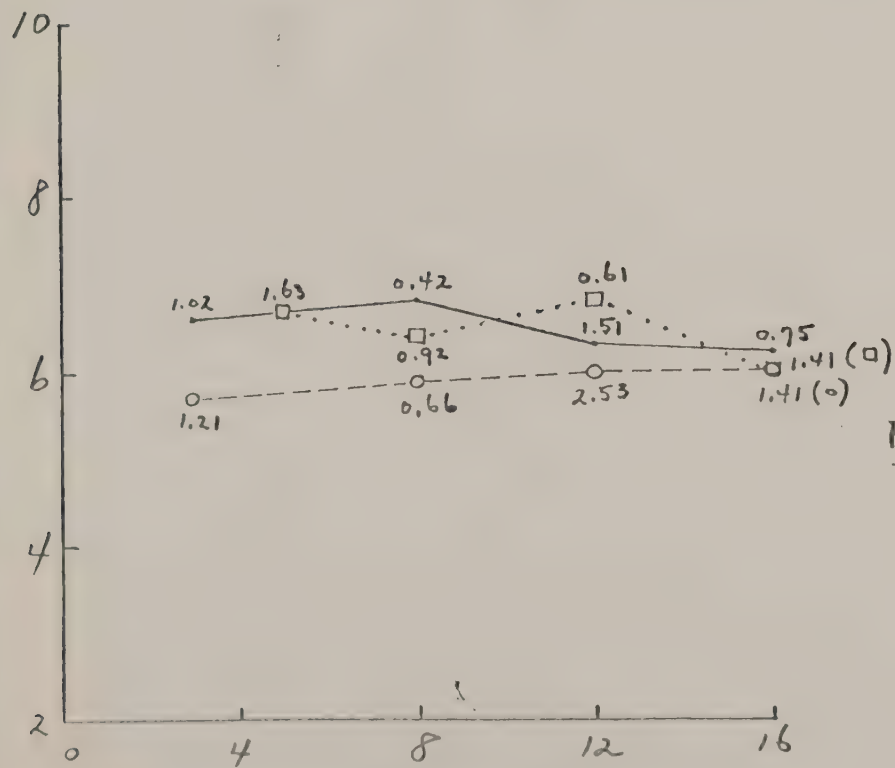

FIGURE F2

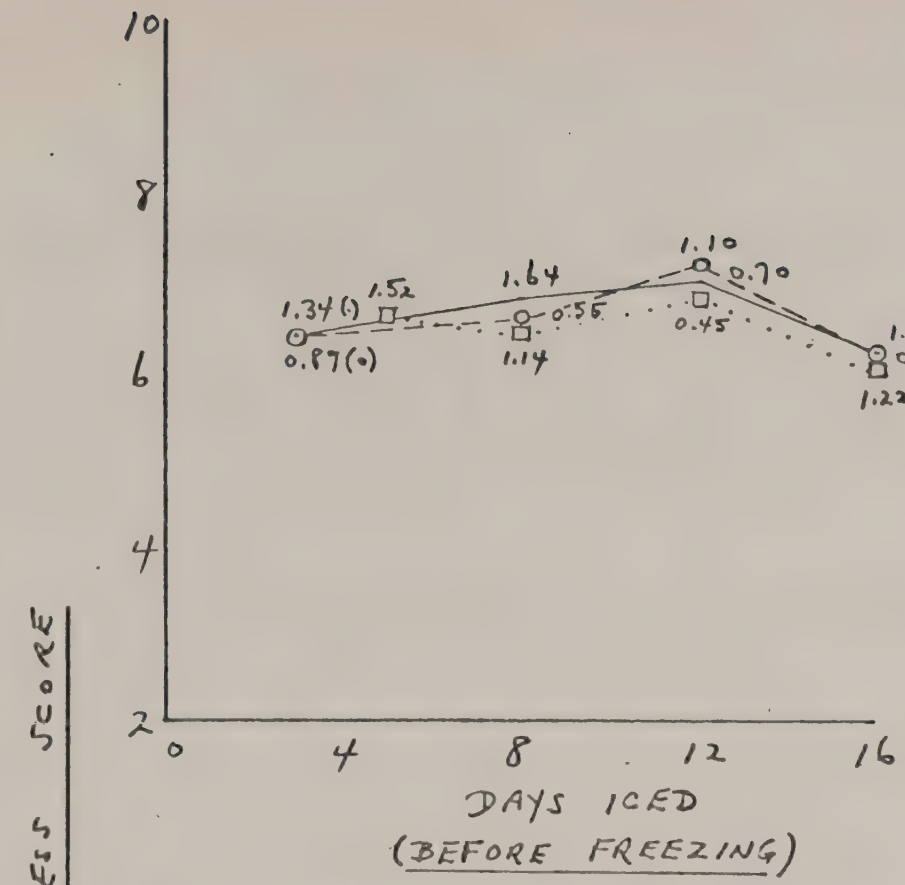

FIGURE F3

JUICINESS SCORE

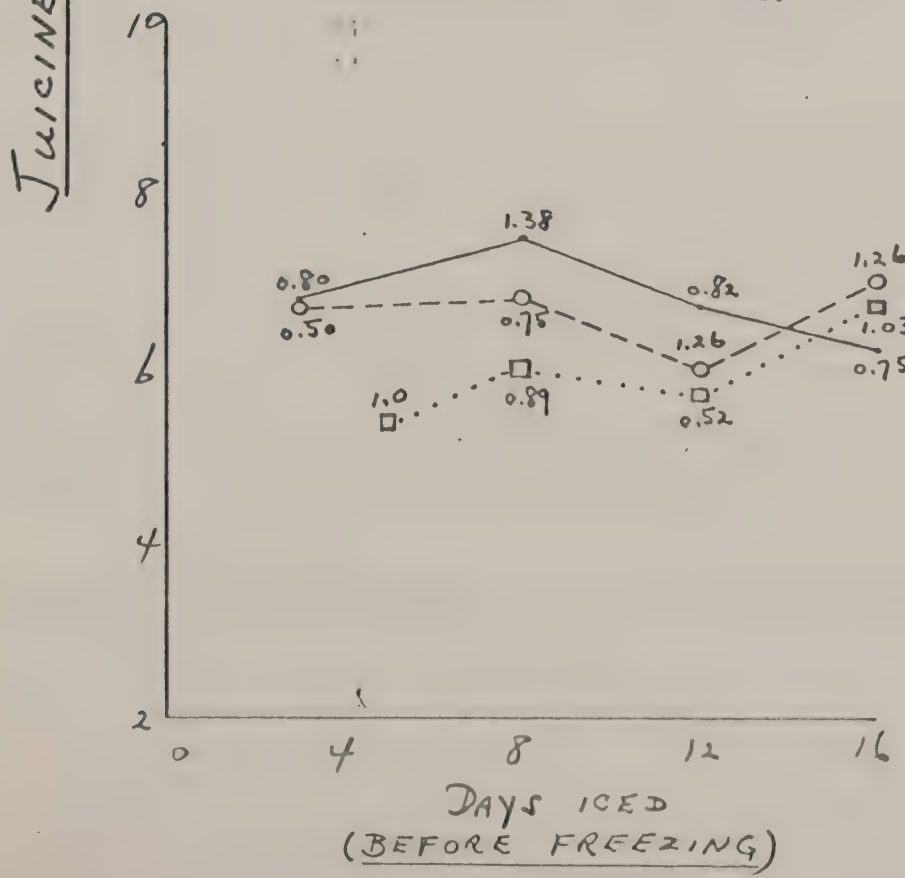

FIGURE F4

(e) Odor, flavor, tenderness and juiciness of frozen fillets prepared from fish of mixed age in ice and from prerigor fish, and of prerigor-frozen, eviscerated fish, after storage

The data for Figures G1 to 4 were obtained by calculating the mean score for each species of all the frozen fillets prepared from iced fish at all sampling periods, the zero time score being that for the fish before being frozen. The figures, therefore, may be taken to approximate the result to be expected if the combined catch of each species taken in an extended fishing trip (16 days) was mixed and used in preparation of frozen fillets.

It will be seen that S. alutus and S. reedi when stored as frozen fillet blocks at -22°F lost little in quality as judged by taste panel during one year of storage. The quality of S. proriger, however, declined somewhat more rapidly, particularly in flavor.

It will also be seen that the mixing of fish from an unduly long trip can result in a frozen product that in the early stages of storage will receive mean odor and flavor scores about 1 unit lower than if the fish were from a trip in which the oldest fish did not exceed 8 days in ice at processing (compare Fig. C1 to 4 and D1 to 4 with G1 and G2, respectively). Although the difference in scores diminished with time, it would be desirable to limit the iced storage of round fish for use in preparation of frozen products to about 8 days.

The fillets frozen prerigor at sea (Fig. H1 to 4) were definitely inferior in flavor and tenderness to prerigor-frozen, eviscerated fish and to fillets prepared and frozen from iced fish. Their lower tenderness likely originated in contracture of the fillets during onset of rigor mortis before they froze (this does not occur when whole fish are frozen), but the reason for their impaired flavor is not clear. One possibility is that as the blocks were frozen on shelves at sea they were more open in structure than were the compressed blocks frozen in the vertical plate freezer ashore and, therefore, were more susceptible to oxidative rancidity. Insofar as odor and flavor are concerned, with these "prerigor" blocks, S. alutus was inferior to the others. If, in the future, it was intended to freeze fillets of these species at sea, it would be necessary to investigate the procedure in detail to ascertain the source of the inferior quality observed and to find means of obviating it.

All prerigor-frozen, eviscerated fish kept well during the year of storage (Fig. H1 to 4), S. proriger, under these conditions, being equal to, or even slightly superior to the others.

Figures G1 to 4 and H1 to 4

Taste panel scores for odor (G1, H1), flavor (G2, H2), tenderness (G3, H3) and juiciness (G4, H4) of 3 species of Sebastes (rockfish) in relation to duration of frozen storage.

Figures G1 to 4 record mean scores (n=24, except for zero time - see below) after 60, 180 and 366 days of frozen storage (-22°F) for all fillets prepared from previously iced fish (i.e., the means of combined scores for fillets from fish stored 3 (or 5), 8, 12 and 16 days in ice before being filleted). The zero time scores are the means (n=72) for the iced fish before preparation and freezing of the fillets.

Figures H1 to 4 record mean scores for fish frozen at sea within 8 hours of being caught, either as eviscerated whole fish (n=72 at zero time, otherwise 18), or as fillets (n=30).

Mean scores for:

S. alutus (Pacific Ocean perch) frozen after being iced or as freshly caught, eviscerated fish

S. reedi (Yellowmouth rockfish), large,

S. reedi (" "), small,

S. proriger (Redstripe rockfish)

Mean scores for:

S. alutus frozen as fillets at sea

S. reedi, " " " " "

S. proriger " " " " "

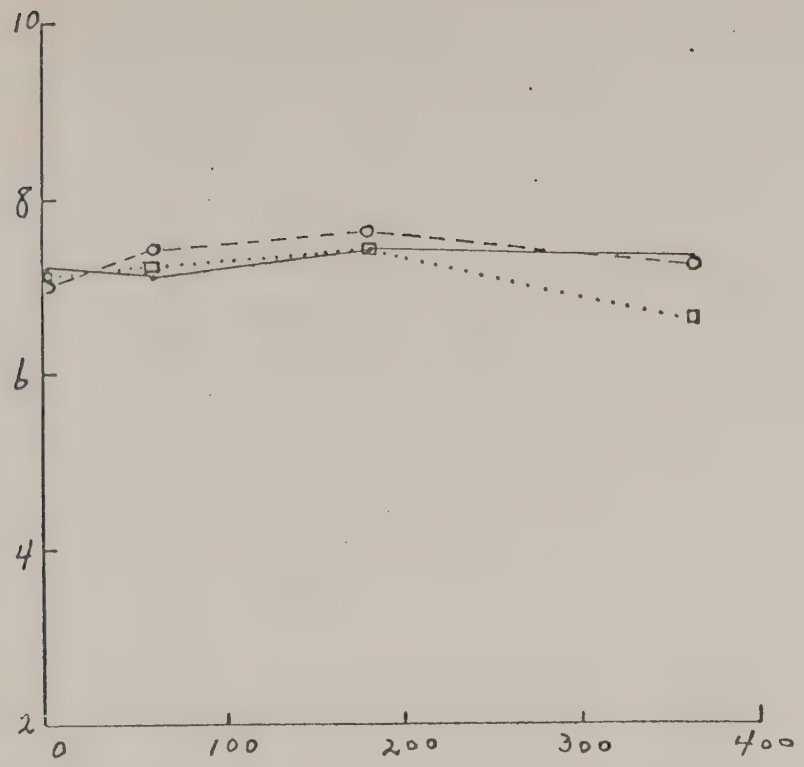

FIGURE G1

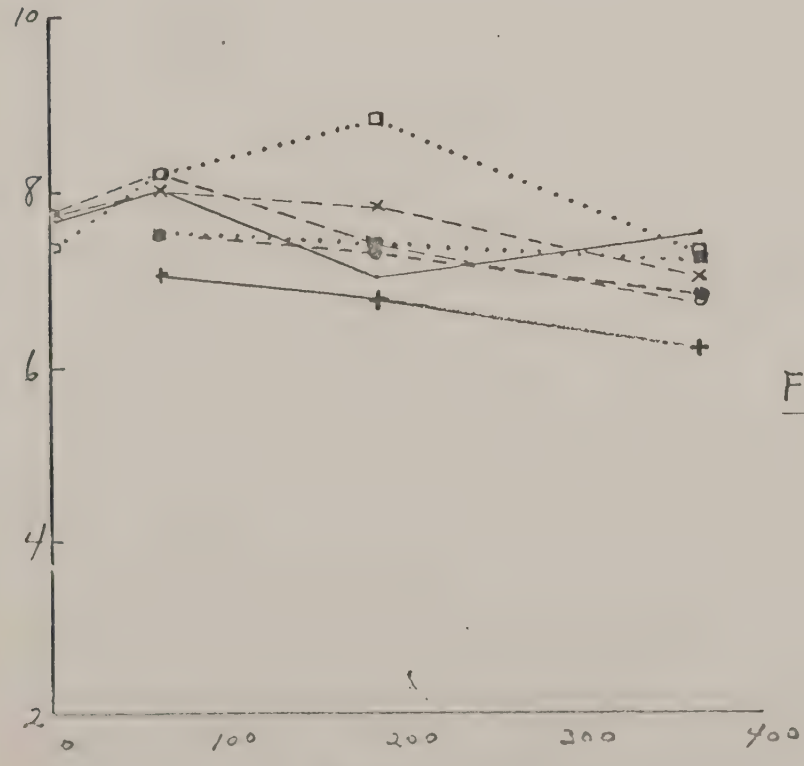

FIGURE H1

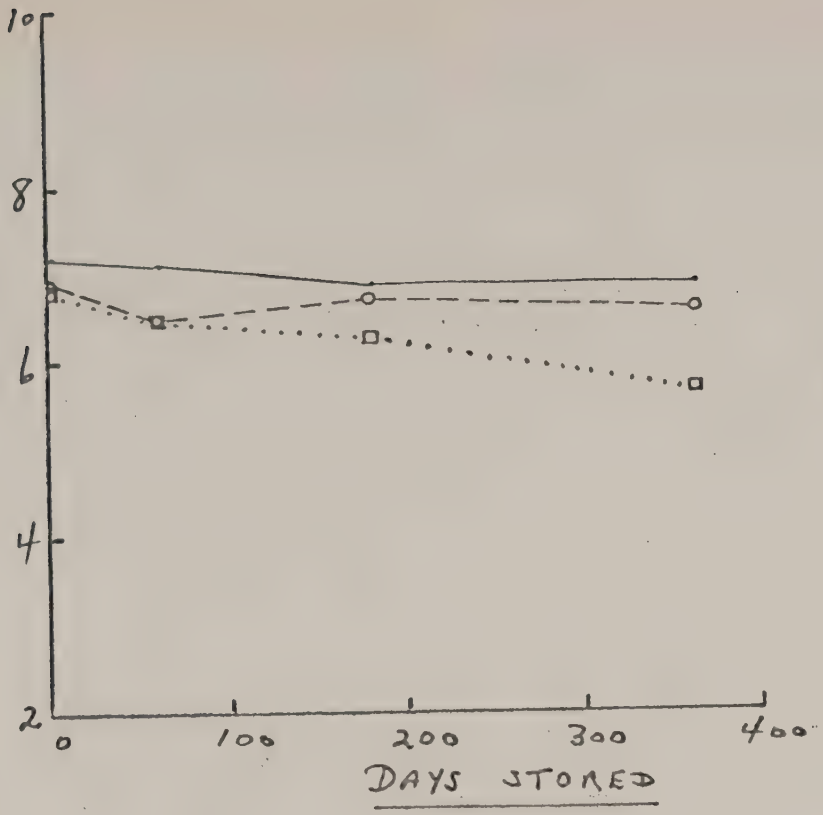

FIGURE G2

FLAVOR SCORE

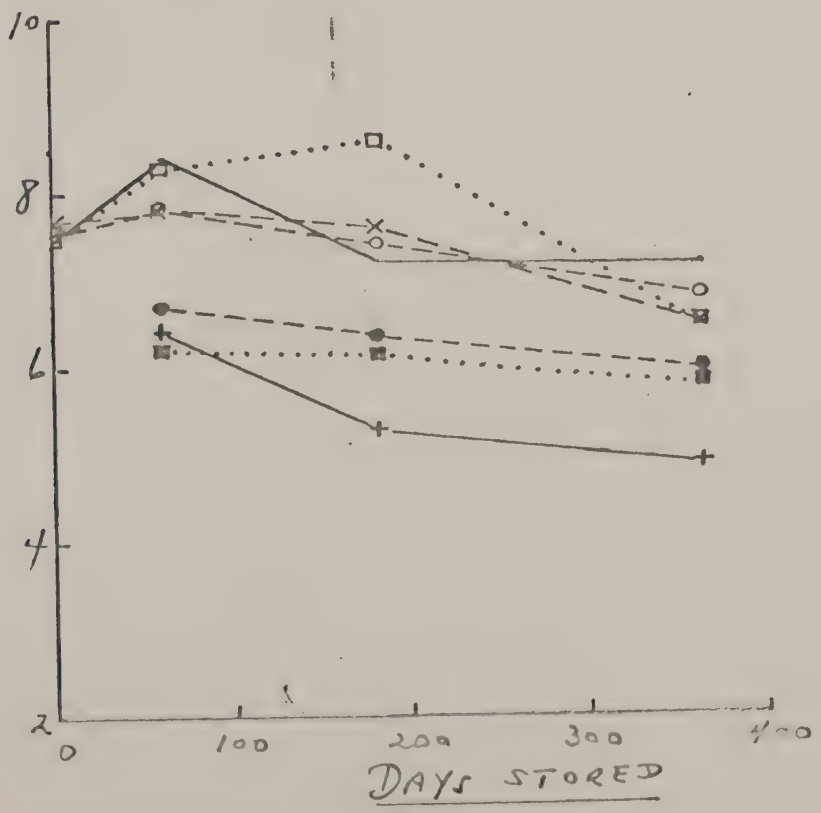

FIGURE H2

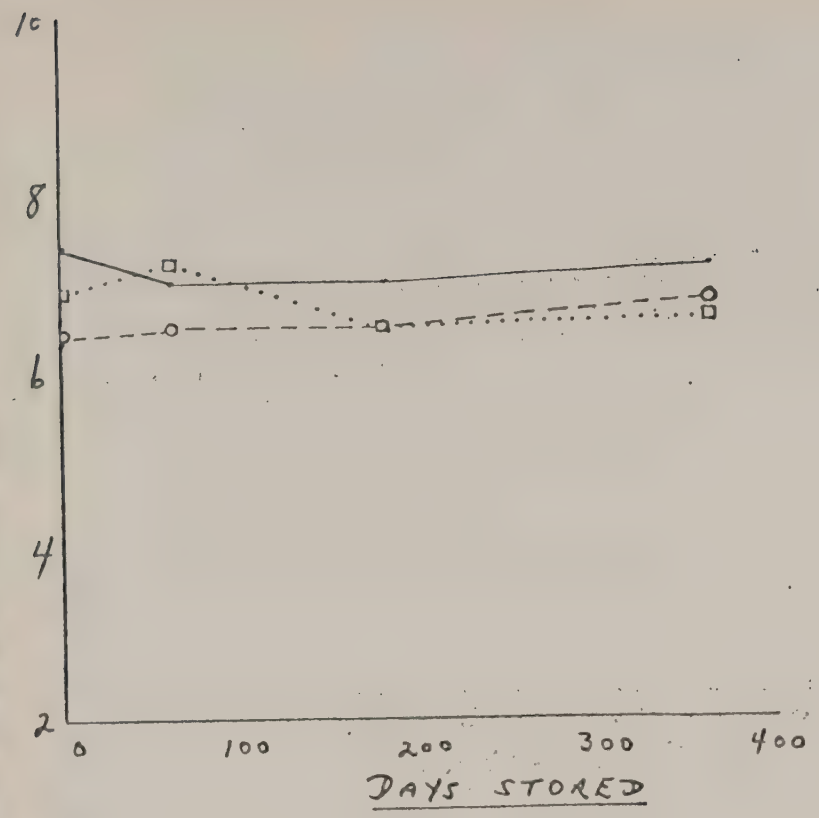

FIGURE G3

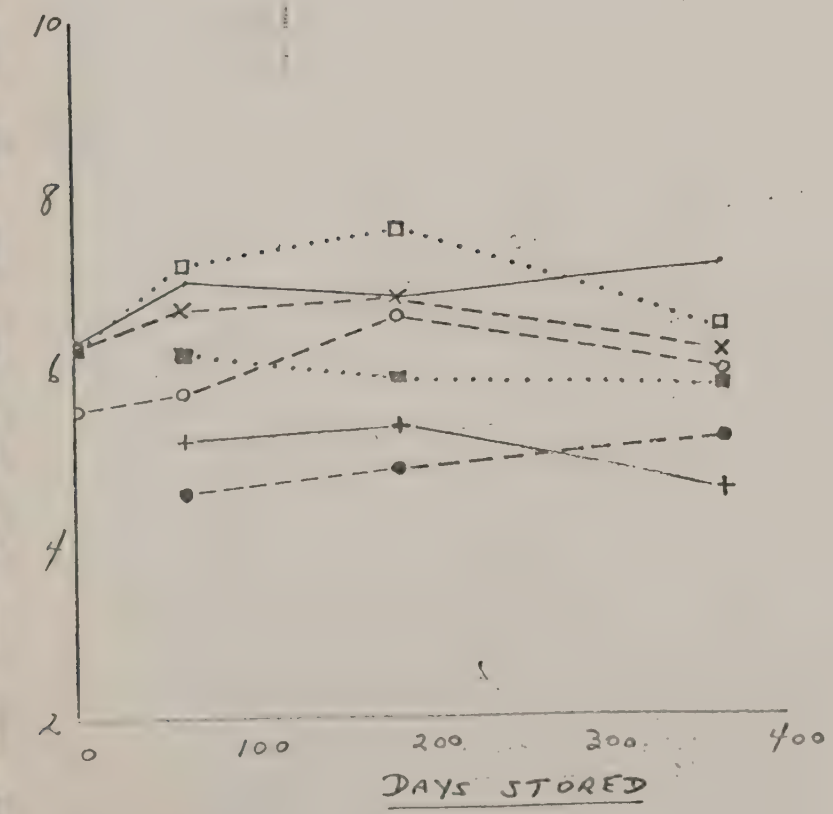

FIGURE H3

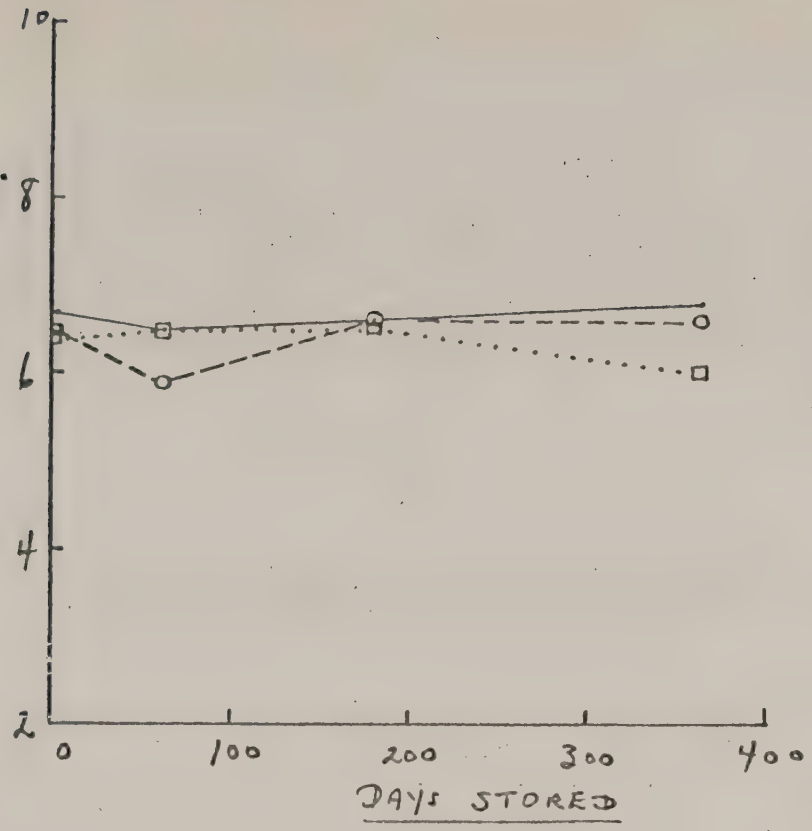

FIGURE G4

JUICINESS SCORE

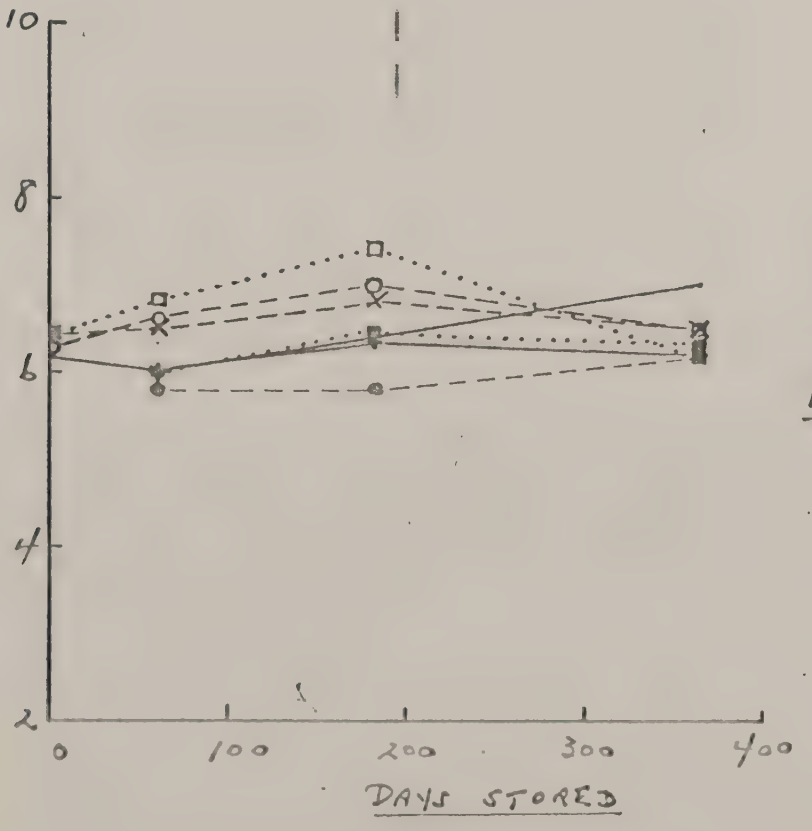

FIGURE H4

(f) Free drip from thawing fillets

Free drip formed during thawing of frozen fillets after 366 days of frozen storage is recorded in Table 2. Drip was least from fillets sawn from prerigor-frozen, eviscerated whole fish; greatest from prerigor frozen fillets; and of generally intermediate quantity from fillets prepared from fish iced before being filleted and frozen.

Table 2

Free Drip Formed During Thawing of Frozen Fillets of 3 Species of Pacific Rockfish After 366 Days of Frozen Storage

Fillets frozen from	Free drip (% of fillet weight) from fillets of S. alutus	S. proriger	S. reedi
Fish iced 4 days	3.6	6.2	5.4
" " 8 "	6.5	7.0	6.5
" " 12 "	6.2	5.4	11.2
" " 16 "	7.8	7.8	8.4
" " 4 to 16 days (mean)	6.0	6.6	7.9
Prerigor fish	16.0	14.0	15.3
Prerigor-frozen, eviscerated fish	3.9	3.9	large - 3.2 small - 5.7

Values for free drip after 60 and 180 days of frozen storage were similar, with similar fluctuations and a small overall tendency to increase during frozen storage was evident. There was little to choose between the 3 species insofar as free drip was concerned. The values for fillets cut from prerigor-frozen, eviscerated fish were similar to those found previously for S. alutus and 2 other species of Pacific rockfish similarly treated (Tomlinson et al, 1969).

(g) Flesh pH in relation to tenderness, juiciness and free drip

In some species of fish (e.g. halibut, Tomlinson et al, 1973; 1966) flesh pH exerts a marked effect on tenderness and juiciness of the cooked flesh and on free drip formation. In the present investigation, however, flesh pH did not correlate with either of the taste panel scores or with free drip, indicating that the flesh proteins of Sebastes may perhaps be somewhat more stable than those of certain other species.

(h) Mercury content of flesh

The flesh of a number of fish of each of the 3 species was analyzed for mercury by the Fish Inspection Laboratory, Industrial Service Branch, Fisheries and Marine Service, Department of the Environment, Vancouver, B.C. The mercury content of the flesh of all the fish (Table 3) was well within the tolerance limit for fish (0.5 ppm).

Table 3

Mercury in the flesh of S. alutus, S. proriger, and S. reedi

Species	Mercury concentration in flesh	
	Mean	Range
	ppm	ppm
S. alutus (12 fish)	.103	.02 - .32
S. proriger (12 fish)	.073	.03 - .11
S. reedi (6 fish)	.113	.06 - .19

(i) Taste panel scores for commercially frozen ocean perch (Atlantic)

Five separate 1 lb packages of ocean perch (Atlantic) of unknown storage history were purchased from Vancouver retail stores and were presented, unidentified, to a taste panel mixed with the experimental samples during their examination after 366 days of frozen storage. Mean scores (n=30) for the commercial samples were as follows (S.D. in brackets):

Odor	6.7(1.34)
Flavor	4.7(1.67)
Tenderness	7.1(1.14)
Juiciness	6.1(1.11)

The scores for the experimental frozen samples prepared from iced Pacific rockfish compare favorably with these scores.

(j) Specialty restaurant evaluation of prerigor-frozen, eviscerated fish

Mr. D.D. Wilson, Manager, Industrial Service Branch, Pacific Region, Fisheries and Marine Service, Department of the Environment, arranged for a 100 lb block of each of the 3 species, frozen prerigor as eviscerated fish, to be evaluated by a Chinese specialty restaurant in Honolulu. The following is an excerpt from a letter to Mr. Wilson from the restaurant owner:

> "We experimented with the three species of fishes prepared in the Chinese manner, and found them to be acceptable. We can use all three species in the manner that you shipped the samples, whole, head on, but gutted."

SUMMARY

The recently described rockfish, Sebastes reedi (Yellowmouth rockfish) has been compared with S. alutus (Pacific Ocean perch) and S. proriger (Redstripe rockfish) to ascertain if it might be suitable for marketing with them with the following results:

1) No differences in initial odor and flavor of the cooked flesh of the 3 species attributable to species were detected by taste panel.

2) The useful storage life in ice for round fish of each species for use unfrozen was 10 to 12 days, but for preparation of frozen fillets of best quality the limit for iced storage was about 8 days.

3) Taste panel odor and flavor scores for the cooked flesh of fish stored up to 8 days in ice were very good and similar for all 3 species and very similar to those for flesh from eviscerated fish frozen prerigor at sea and stored for the same time. For frozen fillets prepared from previously iced S. alutus and S. reedi the scores declined only slowly during 1 year of storage, at the end of which they were still acceptable; but for S. proriger they declined more rapidly and were of borderline acceptability. The scores for all 3 species frozen prerigor as eviscerated fish declined slowly, being still acceptable at the end of 1 year.

4) Taste panel scores for tenderness for iced fish, for frozen fillets from previously iced fish, and for prerigor-frozen, eviscerated fish were lower for large S. reedi (mean weight 3.2 lb) than were those for the other 2 species (Mean weights 1.4 and 1.8 lb) and for small S. reedi (mean weight 1.1 lb), all of which were equally tender.

5) Taste panel scores for juiciness of the cooked flesh of the 3 species were acceptable and similar to each other under each condition of treatment and storage.

6) Taste panel scores for flavor and tenderness were inferior for fillets of all 3 species frozen prerigor at sea to those for prerigor-frozen, eviscerated fish and for frozen fillets from iced fish.

7) The percentage weight loss resulting from free drip formation during the thawing of frozen fillets was much the same from each of the species.

8) The mercury content of the flesh of all 3 species was well within the tolerance level for fish (0.5 ppm).

9) Taste panel scores for frozen fillets prepared from the previously iced Pacific rockfish compared favorably with those for commercially available ocean perch from the Atlantic.

10) The 3 species, frozen prerigor, eviscerated, were found to be equally acceptable by a Chinese specialty restaurant.

CONCLUSIONS

As iced fish, as frozen fillets prepared from previously iced fish, and as prerigor-frozen, eviscerated fish, S. alutus and S. reedi are sufficiently alike that they could be considered for marketing together. The only obvious difference found, the somewhat lower tenderness of large S. reedi, is probably related to the difference in the size of the fish examined, rather than species, and does not appear to be of sufficient seriousness to warrant separate marketing.

As iced fish, and as prerigor-frozen, eviscerated fish, S. proriger is the equal of the other species and could be considered for marketing with them. As frozen fillets prepared from previously iced fish, its somewhat inferior keeping quality under this condition suggests separate marketing in this particular form if storage beyond 3 or 4 months is contemplated. It is possible that this difference for S. proriger is also related to size, for the particular fish of the species caught were smaller than the S. alutus and S. reedi with which they were compared.

ACKNOWLEDGMENTS

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REFERENCES

Anon. 1961. Inspectors' instructions for grading frozen cod fillets. U.S. Bureau of Commercial Fisheries, Washington, D.C., pp. 24-26.

Elliott, R.P., and K.L. Osterhaug. 1946. Palatability of Pacific rockfish fillets. Com. Fish. Rev., 8(10): 4-8.

Harling, W.R., D. Davenport, M.S. Smith, R.M. Wowchuk, and S.J. Westrheim. 1971. G.B. Reed groundfish cruise No. 71-3, October 1-29, 1971. Fish. Res. Bd. Canada Tech. Rept. No. 290, 35pp.

Tomlinson, N., S.E. Geiger, and E. Dollinger. 1966. Free drip, flesh pH and chalkiness in halibut. J. Fish. Res. Bd. Canada 23(5): 673-680.

Tomlinson, N., S.E. Geiger, D.E. Kramer and S.W. Roach. 1973. The keeping quality of frozen halibut in relation to prefreezing storage. Fish. Res. Bd. Canada Tech. Rept. No. 353, 21pp.

Tomlinson, N., S.E. Geiger and S.W. Roach. 1969. Quality of sea frozen fish from the north-eastern Pacific ocean. In Freezing and Irradiation of Fish. Ed R. Kreuzer. Fishing News (Books) Ltd., London. 68-75.

Westrheim, S.J., and H. Tsuyuki. 1967. Sebastodes reedi, a new scorpaenid fish in the northeast Pacific Ocean. J. Fish. Res. Bd. Canada 24(9): 1945-1954.